

Additional Information in Support of  
Straight Creek UAA Proposal  
and in Response to Comments at Public Meeting on January 26, 2007

1. Existing Use Status

- a. Available historical information regarding Straight Creek's biological condition indicates that:
  - i. Sensitive organisms were likely impacted very early in development of the watershed. Mining and timbering operations developed beginning in 1905 (TVA 1965), and the "...decline of mussel fauna in the Powell River in Virginia was prophesied by Ortmann (1918).
  - ii. Fish populations in Straight Creek are likely no worse today than they were in 1968.
    - 1. Preliminary TVA fisheries data indicate that a 1968 fish survey in the North Fork Powell River upstream of Straight Creek identified 17 species.
    - 2. The mouth of Straight Creek could be reasonably expected to support similar species diversity in 1968 since fish communities at the mouths of tributaries typically resemble fish communities in their receiving streams.
    - 3. A fish survey of Straight Creek in 2006 identified 17 species, 11 of which were common to the 1968 TVA NFP survey.
    - 4. Variations in diversity can be expected due to landscape variables such as stream order and gradient (Angermeier & Winston 1999), but these preliminary data suggest that fish diversity in Straight Creek is no different today than it was in 1968.
- b. Additional biological information will be collected and examined during the UAA process. Available information indicates that the current

Designated Aquatic Life Use (DALU) is not an existing use for each of the following reasons:

- i. The DALU is expressed as a narrative statement under Virginia law without corresponding numeric criteria. The DALU attainment criterion is defined by agency policy as a “Nonimpaired” rating for benthic assessment using DEQ’s RBP assessment method (VDEQ 2006(a)).
- ii. Straight Creek has been identified as not meeting its DALU on Virginia’s 303(d) list since 1996.
- iii. Benthic data in the Straight Creek TMDL report indicate an average (n=13, 1991-2004) RBP rating of “Moderately Impaired” (40% comparable to reference) and a VASCI score of “Severe Stress” (38 out of 100). Note: see *Using Probabilistic Monitoring Data to Validate the Non-Coastal Virginia Stream Condition Index* (VDEQ 2006(b)) for a full description of VASCI scoring.
- iv. Due to SMCRA required improvements, water quality is likely no worse today than it was in 1975
  1. The U. S. Geological Survey noted that water quality was generally worse pre-SMCRA than after SMCRA-mandated reclamation (USGS 2000)
  2. A declining population (an estimated 1,353 - Straight Creek TMDL report) and the installation of a sewer system for portions of the area suggest that water quality problems are less severe today than in 1950.
- v. Judging by the remaining infrastructure, the urbanization modifications of Straight Creek have likely exerted continuous stress on aquatic life since development peaked in the 1950s. Current land use impacts are likely no worse than pre-1975 impacts based on reports from the 1960s (TVA 1963, 1965).

1. Intensive development of the watershed began in the early 20<sup>th</sup> century (St. Charles est. c.1906), peaking around 1940-1950.
  2. Populations were highest around 1950
    - a. St. Charles – 550
    - b. Bonny Blue (Baileys Trace headwaters) ~3,000
    - c. Benedict (Straight Creek headwaters) ~1,500
  3. Most infrastructure remains – 1200 structures, plus roads, bridges, rail, etc. – but populations sharply declined as of 1960
    - a. St. Charles – 368
    - b. Bonny Blue – 130
    - c. Benedict - 30
- vi. Despite some improvement in water quality and efforts to address land use impacts, the DALU is still not attained. Therefore, based on the information available, the DALU (as defined using DEQ policy) was likely never attained on or after November 28, 1975. The UAA process will include a detailed assessment of the nature and extent of any existing uses, as well as the highest attainable uses.
2. Available information showing that human caused conditions and/or hydrologic modification may be limiting use attainment includes the following physical and water quality information:
    - a. Estimated extent of Straight Creek with some type of channel alteration: nearly 100% of the approximately 6 miles. Approximately 3.9 miles are dramatically altered. These modifications include walls, revetment, diversion, relocation, shoring, incision, bank clearing, and dredging. For example:
      - i. Walls – 1.1 mi near St. Charles since at least 1965 (TVA 1965); In 2007 - approx. 1.5 mi of stream with one or both banks walled,

about 50% of the channel from St. Charles to Monarch

- ii. Channel Incision – Straight Creek and Baileys Trace banks near St. Charles *averaged* 4 ft above water surface in 1960s (TVA 1965). This is characteristic of most of the watershed based on preliminary visual estimates.
- iii. Revetment – Channel revetment of varied magnitude has occurred with streamside residential development for approximately 2.5 miles from below Stone Creek upstream to St. Charles.

b. Estimated extent of historical flooding and flood control measures

- i. Substantial flooding occurred in the watershed, with significant damage from 5-yr flood events. Initial investigations of historical records and citizen interviews have identified 15 major floods in St. Charles: Jan 1918, Dec 1926, Mar 1929, Jan 1932, Mar 1934, Feb 1939, Feb 1944, Jan 1946, Feb 1948, Jul 1949, Dec 1949, Jan 1957, Jan 1959, Mar 1963, and Apr 1977.
- ii. Recognizing the need for flood control, TVA to create an immediate flood relief plan in 1963 and a longer term plan in 1965 for St. Charles.
  - 1. The plans consisted of “...bank clearing and...dredging and cleaning of both [Straight Creek and Baileys Trace] stream channels through town...”
  - 2. The plans called for clearing and dredging of 6000 feet in Straight Creek and 2000 feet in Baileys Trace.

c. Estimated proportion of watershed where Rosgen stream channel and riparian zone restoration could be conducted

- i. Approximately 80% of the nearly 1200 structures in the watershed are located within 200 ft of the stream bank.
- ii. Upstream of Monarch – about ¼ mile
- iii. Monarch to St. Charles – little or no room; road is at most 17m from stream and residential lawns or railroad abut the stream.
- iv. St. Charles to Maness – approximately ¾ mile meets spatial

requirements

- v. Maness to Stone Creek – approximately ¼ mile has potential
  - vi. Baileys Trace – one bank is paved road, the other bank is steep mountainside for most of its length
  - vii. Gin Creek – one bank is road, the other bank is residential lawns for most of its length
  - viii. Stone Creek to Mouth – approximately 0.15 of 0.4 mile
  - ix. Estimated proportion of Straight Creek within 10m of road: 80%
  - x. Estimated proportion of Straight Creek abutting railroad bed: 60%
  - xi. Estimated proportion of Straight Creek banks that are privately owned: at least one bank for most of its length
- d. DEQ field biologist comments indicate that habitat may be limiting the benthic community. Field logsheets for RBP Habitat Assessment were provided to the Group by DEQ during TMDL development. Several of the logsheets indicate the biologist's professional opinion that habitat conditions may be limiting the benthic community.
- e. Quantitative EMAP Physical Habitat surveys were conducted at four sites in Straight Creek (concurrent with DEQ monitoring sites) and one site each in four tributaries (Stone Cr., Pucketts Cr., Baileys Tr., Gin Cr.). Preliminary data for key metrics are presented in Table 1.

**Table 1. Preliminary EMAP Physical Habitat Data for Straight Creek Watershed (8 sites total)**

<b>Channel Morphology</b>	<b>Mean</b>	<b>Substrate</b>	<b>Mean</b>
Incision height (m)	2.2	Est. geometric mean substrate dia. (mm)	35
		Log <sub>10</sub> Relative Bed Stability	-0.4 (Impaired)
<b>Fish Cover and Woody Debris</b>	<b>Mean</b>	<b>Riparian Vegetation Cover and Structure</b>	<b>Mean</b>
Large woody debris (areal proportion)	0	Canopy density at bank (%)	60
<b>Riparian Human Disturbance</b> (proximity-weighted metrics: 0 = not observed, 1.5 = on bank throughout reach)			
<b>Small scale disturbances</b>	<b>Mean</b>	<b>Large scale disturbances</b>	<b>Mean</b>
Walls/Channel Revetment	1.13	Row Crops	0.0
Buildings	0.53	Pastures	0.0
Pavement	0.61	Logging	0.0
Roads/Railroads	0.71	Mining	0.0
Pipes	0.41		
Trash	1.18		
Lawns	0.44		
<i>Small-scale weighted sum (max = 10.5)</i>	<i>5.01</i>	<i>Large-scale weighted sum (max = 4)</i>	<i>0</i>
<b>All Types</b> (proximity-weighted sum of 11 types; max = 16.5)			<b>5.01</b>

- i. Absolutely no Large Woody Debris (LWD) was observed. LWD provides important fish habitat and hydraulic energy dissipation. Most LWD was likely washed out through flooding or removed manually to prevent flooding. Restoring LWD would run counter to flood control efforts and vice versa.
- ii. Streambed substrate is unstable at all sites. All sites rate “Impaired” for benthic invertebrate assemblages in the Mid-Atlantic Highland region as determined by regional stream ecologists (Kauffmann et al 1999).
- iii. Mean substrate particle size is smaller than in other ecoregion streams of similar gradient (USEPA MAIA 1997-98 data). Flood energy greatly influences substrate particle size and stability.
- iv. Incision height is about twice as great as other ecoregion streams (USEPA MAIA 97-98), resulting in flood hydraulic energy being confined to the channel and substrate.
- v. Bank canopy density averaged 60% for the surveyed reaches. This number is lower than the 90% bank canopy for other streams in the

ecoregion (USEPA MAIA 97-98). The 60% canopy observed is likely not representative of the entire watershed since EMAP sites were generally not coincident with heavy development. The exception was the station at RM 0.40, where bank canopy density was only 23% due to residential development on both banks.

- vi. Small-scale human disturbance was on average observed over nearly half the length surveyed ( $5.01/10.5 = 47.7\%$ ) and within or adjacent to the 10m riparian corridor. This may be an underestimate since sites were generally not located near heavy development.
- f. Riparian and instream disturbances have likely induced and currently maintain a substantial shift in stream ecosystem energy source.
  - i. Benthic invertebrate assemblage data indicate an altered food web, which is one of five ecological factors influencing the aquatic community (USEPA 2005).
  - ii. The benthic community is 35.2% filter-feeders (based on 13 benthic samples from 1991 – 2004 listed in the Straight Creek TMDL report).
  - iii. Removal of the canopy has increased the stream's exposure to sunlight. This has likely contributed to an increase in primary production and available suspended food for the filter-feeding organisms.
- g. Available information about water quality limitations includes:
  - i. The TMDL report for Straight Creek specifies a 48% reduction in TDS loading from overland and rainfall driven load sources.
  - ii. TDS concentration (not loading) is what is important to aquatic organisms (toxicity, osmotic stress, etc.).
  - iii. TDS concentration (as measured with a continuous conductivity logger) was observed to be highest during the low precipitation and/or low flow times of year (Figure 1) in Straight Creek (RM 0.11).

- iv. TDS concentration (conductivity) dropped dramatically in direct response to rainfall (Figure 1).
- v. When the TDS concentration is highest, the source cannot be attributed to overland flow (e.g. surface runoff).
- vi. Conventional/cost effective measures (e.g., sediment ponds) to control TDS loading from overland sources during runoff events are likely ineffective at controlling in-stream TDS concentrations at low flow periods.
- vii. High in-stream TDS concentrations are attributable to infiltration and interflow (i.e. underground mine works, AML, AMD, etc.) (Straight Creek TMDL report).
- viii. Due to practical limitations and concern for human safety, remediation of underground mine works are likely infeasible. Specifically, mine blowouts can occur when there is a significant buildup of pressure from sealing a mine and pose a threat to both the environment as well as human life (KDSMRE 1994).
- ix. The effect on TDS in groundwater from reclaiming AML surface disturbances is variable.
  - 1. Areas that have a rough surface and retain water may have some potential for reducing infiltration/interflow through re-grading and re-vegetation. However, by reducing infiltration, overland flow may be increased thereby increasing hydraulic energy in the stream channel. This may exacerbate the problematic flash flooding in the watershed.
  - 2. Conventional AMD treatments (e.g., liming, limestone addition, anoxic drains) were designed to reduce acid and metals and will likely increase TDS concentration by increasing the in-stream dissolved calcium concentration.
- x. Available information suggests that historic land uses in Straight Creek may inhibit reductions in critical in-stream TDS

concentrations. The UAA study will further examine the feasibility of TDS reductions. In addition, as part of TMDL implementation, monitoring associated with required effluent limits and cost-effective/reasonable BMPs will help project TDS reductions and their impact on aquatic life.

3. Cost Estimates for Attaining DALU

a. AML reclamation (DMLR est.):

\$10,000/acre x 2100 acres = **approx. \$21 million**

b. Stream channel restoration following Rosgen methods (estimated, for approx. 6 miles of Straight Creek mainstem)

i. Instream habitat (USFS 2004, CH2M Hill 2003):

\$150-300/ft x 6 mi = **approx. \$4.75 - \$9.5 million**

ii. Riparian corridor (USDA Forest Service 2003):

\$2,500/acre x 6 mi x 10m buffer per bank = **approx. \$120,000**

c. Total estimated costs for AML and channel/riparian restoration in Straight Creek mainstem ONLY: up to **\$30.6 million;**

d. Total estimated costs for restoration of AML and all 38.1 miles of stream in watershed: up to **\$81 million**

e. These cost estimates assume that the necessary space is available for riparian restoration. Most of the watershed has private land adjacent to the stream. Relocation of structures and other improvements will increase total restoration costs.

4. Refinement of uses and criteria (e.g., Tiered Aquatic Life Uses) is one approach to meet minimum national water quality goals

a. Other States' UAA efforts and TALUs

i. Virginia – designated tiered aquatic life uses for the Chesapeake Bay and then assigned a range of water quality criteria to meet these different tiers.

- ii. Idaho – conducted UAA and removed ALU based on mining-related human caused conditions
  - iii. Maine – has limited-use ALU tier to allow for changes in benthic community composition
  - iv. Colorado – conducted UAA and removed ALU for “legacy mining sites”
  - v. Minnesota – has focused UAA efforts on addressing hydrologic modifications (i.e., “canalization”)
  - vi. Ohio – conducts a UAA and designates “Modified Warmwater Habitat” ALU where a stream fails to meet all of the criteria for other ALU tiers.
- b. Virginia’s SCI validation report proposes ALU tiers along with numeric criteria corresponding to SCI scores.

## 5. Summary

- a. Available information suggests that Straight Creek has not attained its DALU on or after November 28, 1975. Land uses and their impacts on aquatic life have likely remained constant or improved since 1975. Therefore, it is not likely that Straight Creek ever attained the DALU as interpreted by agency policy.
- b. Restoration costs for AML reclamation and stream channel restoration may approach \$81 million. More comprehensive cost estimates will be developed during the UAA process.
- c. The UAA process and ALU refinement are sound management tools as demonstrated by their use in Virginia and other states. Refinement of uses and associated criteria can help ensure realistic and achievable water quality goals.
- d. Human caused conditions and/or hydrologic modifications may be limiting DALU attainment. A UAA will be useful to further quantify the limiting factors and determine the highest potential biological condition.
  - i. The physical factors impacting aquatic life have been extensively

modified by over 100 years of development in the watershed. Most of that modification is likely not remediable and therefore limits aquatic life potential. The human need to prevent flood damage to property is at odds with the aquatic life needs of instream and riparian habitat, natural flow regime, and a balanced food web.

- ii. Impacts from TDS may be difficult to remediate due to the complex nature of TDS loading in Straight Creek. Preliminary information suggests that TDS control measures are of little effect during the low flow conditions when TDS most impacts aquatic life. Opportunities for remediation of AML exist, but each opportunity must be evaluated individually to determine feasibility. Conventional AML reclamation may in some cases reduce TDS while exacerbating flash flooding risk in the watershed. In other cases, it may actually increase TDS loading.
- iii. Historical land uses have extensively altered physical, chemical, and biological conditions in the Straight Creek watershed. Due to spatial, technical, social, and natural limitations, these alterations prevent attainment of the Designated Aquatic Life Use.

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Figure 1. Specific Conductivity & Rainfall  
01 Jan06 - 02 Feb06  
Straight Creek RM 0.11

